

JAPAN

EDICT OF GOVERNMENT

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JIS B 9713-4 (2004) (English): Safety of
machinery -- Permanent means of access to
machinery -- Part 4: Fixed ladders

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*The citizens of a nation must
honor the laws of the land.*

Fukuzawa Yukichi

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JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 9713-4 : 2004

(ISO/FDIS 14122-4 : 2002)

(JMF)

**Safety of machinery — Permanent
means of access to machinery —
Part 4 : Fixed ladders**

ICS 13.110

Reference number : JIS B 9713-4 : 2004 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Health, Labour and Welfare and the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from the Japan Machinery Federation (JMF) /the Japanese Standards Association (JSA), with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

This Standard has been made based on ISO/FDIS 14122-4:2002 *Safety of machinery – Permanent means of access to machinery – Part 4: Fixed ladders* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Ministers and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

JIS B 9713 consists of the following parts, under the general title "*Safety of machinery – Permanent means of access to machinery*":

Part 1: Choice of fixed means of access between two levels

Part 2: Working platforms and walkways

Part 3: Stairs, stepladders and guard-rails

Part 4: Fixed ladders.

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In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Safety of machinery—Permanent means of access to machinery—Part 4 : Fixed ladders

Introduction This Japanese Industrial Standard has been prepared based on the first edition of ISO/FDIS 14122-4 *Safety of machinery—Permanent means of access to machinery—Part 4: Fixed ladders* published in 2002 without modifying the technical contents.

The foreword of the original International Standard has been excluded because it is not part of the provisions.

This part of JIS B 9713 is a group safety standard and Part 4 of the series of standards in JIS B 9713.

The provisions of this document may be supplemented or modified by a product safety standard.

- Notes 1 For machines which are covered by the scope of a product safety standard and which have been designed and built according to the provisions of that standard, the provisions of that product safety standard take precedence over the provisions of this group safety standard.
- 2 This Standard requires the manufacturers to provide “safe access to operating position, servicing points and maintenance area” and to prevent “risk of slipping, tripping or falling”.
- 3 See also relevant matters described in 6.2.4 “*Provision for safe access to machinery*” of ISO 12100-2.
- 4 The use of materials other than metals (wood composite materials, so-called “advanced” materials, etc.) does not alter the application of this part of JIS B 9713.

Information : JIS Z 8051:2004 sets up the “hierarchy” of safety standards as follows:

- *basic safety standard*, comprising fundamental concepts, principles and requirements with regard to general safety aspects applicable to a wide range of products, processes and services;
- *group safety standard*, comprising safety aspects applicable to several or a family of similar products, processes or services dealt with by more than one committee, making reference, as far as possible, to basic safety standards;
- *product safety standard*, comprising safety aspect(s) for a specific, or a family of, product(s), process(es) or service(s) within the scope of a single committee, making reference, as far as possible, to basic safety standards and group safety standards;

The purpose of this Standard is to define the general requirements for safe access to machines mentioned in ISO 12100-2. Part 1 of JIS B 9713 gives advice about the correct choice of access means when the necessary access to the machine is not possible

directly from the ground level or from a floor.

1 Scope This Standard applies to all machinery (stationary and mobile) where fixed means of access are necessary.

This Standard applies to fixed ladders which are a part of a machine.

This Standard may also be applied to fixed ladders to that part of the building where the machine is installed, providing the main function of that part of the building is to provide a means of access to the machine.

Note 1 This Standard can be used also for means of access which are outside the scope of this Standard. In those cases the possible relevant national or other regulations should take precedence.

This Standard applies also to ladders which are not permanently fixed to the machine and which may be removed, moved to the side or pivoted (swivel-mounted) for some operations of the machine (e.g. changing tools in a large press).

For the significant hazards covered by this Standard, see clause 4 of JIS B 9713-1.

Note 2 The International Standard corresponding to this part of JIS B 9713 is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21.

ISO/FDIS 14122-4:2002 *Safety of machinery—Permanent means of access to machinery—Part 4: Fixed ladders* (IDT)

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of publication is given to these referred standards, only the edition of the indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply. The normative references without the indication of the year of coming into effect apply only to the most recent edition (including amendments).

JIS B 9713-1 *Safety of machinery—Permanent means of access to machinery—Part 1: Choice of fixed means of between two levels*

Note : ISO 14122-1:2001 *Safety of machinery—Permanent means of access to machinery—Part 1: Choice of fixed means of between two levels* is identical with the said standard.

JIS B 9713-2 *Safety of machinery—Permanent means of access to machinery—Part 2: Working platforms and walkways*

Note : ISO 14122-2:2001 *Safety of machinery—Permanent means of access to*

machinery—Part 2: Working platforms and walkways is identical with the said standard.

JIS B 9713-3 *Safety of machinery—Permanent means of access to machinery—Part 3: Stairs, stepladders and guard-rails*

Note : **ISO 14122-3:2001** *Safety of machinery—Permanent means of access to machinery—Part 3: Stairs, stepladders and guard-rails* is identical with the said standard.

3 Terms and definitions For the purposes of this Standard, the terms and definitions given in clause 3 of **JIS B 9713-1** and the following apply.

The main terms used in this Standard are given as an example in figures 1, 2, 3 and 4.

Information : See **EN 1070** for relevant terms and definitions.

3.1 fixed ladder with two stiles ladder, according to 3.1 of **JIS B 9713-1**, which is stationary and where the rungs are arranged between and attached to the stiles. The stiles carry the load (see figure 2).

3.2 fixed ladder with one stile ladder, according to 3.1 of **JIS B 9713-1**, which is stationary and where the rungs are attached to both sides of the stile. The stile carries the load alone (see figure 3).

3.3 ladder flight continuous part of the fixed ladder (see figure 1):

- between arrival and departure area, in the case of ladders without platforms; or
- between the arrival area and departure area respectively and the nearest platform; or
- between rest platforms following each other

3.4 climbing height H of a fixed ladder total vertical distance between the walking surface of the arrival area at the top of the ladder(s) and the walking surface of the departure area at the base of the ladder(s) (see figure 1).

3.5 height h of the ladder flight vertical distance between the level at the beginning and the level at the end of each flight (see H , h_1 , h_2 , h_3 in figures 1a and 1b)

3.6 fall protection technical measure to prevent or reduce the risk of people falling from fixed ladders

Note : Commonly used fall protection devices are defined in 3.6.1 and 3.6.2.

3.6.1 safety cage assembly which serves to limit the risk of people falling from the ladder (see figure 2)

3.6.2 guided type fall arrester on a rigid anchorage line, fall arrester protective equipment fixed to ladder used in combination with personal protective equipment that everyone has available before being allowed to use the ladder. In the following text the abbreviation “fall arrester” will also be used for this type of fall protection device.

Information : See also definition in **EN 353-1** and **EN 363**.

3.7 arrival level the upper level of the surroundings or of the intermediate platform

to which, the person steps after the ascent (see figure 1)

3.8 departure level the lower level of the surroundings or of the intermediate platform from which the person starts to climb the fixed ladder (see figure 1)

3.9 intermediate platform horizontal structure (platform) between two consecutive flights of a ladder (used with ladders having staggered flights) (see figures 1b and 4b)

3.10 rest platform area equipped with the required protective means designed so that the user of the ladder can have a physical rest (see figures 1b and 10)

3.11 access platform horizontal structure at the arrival or departure area used by a person for means of access

3.12 trap door normally closed device which can be opened to give access through a platform or through other similar horizontal structures

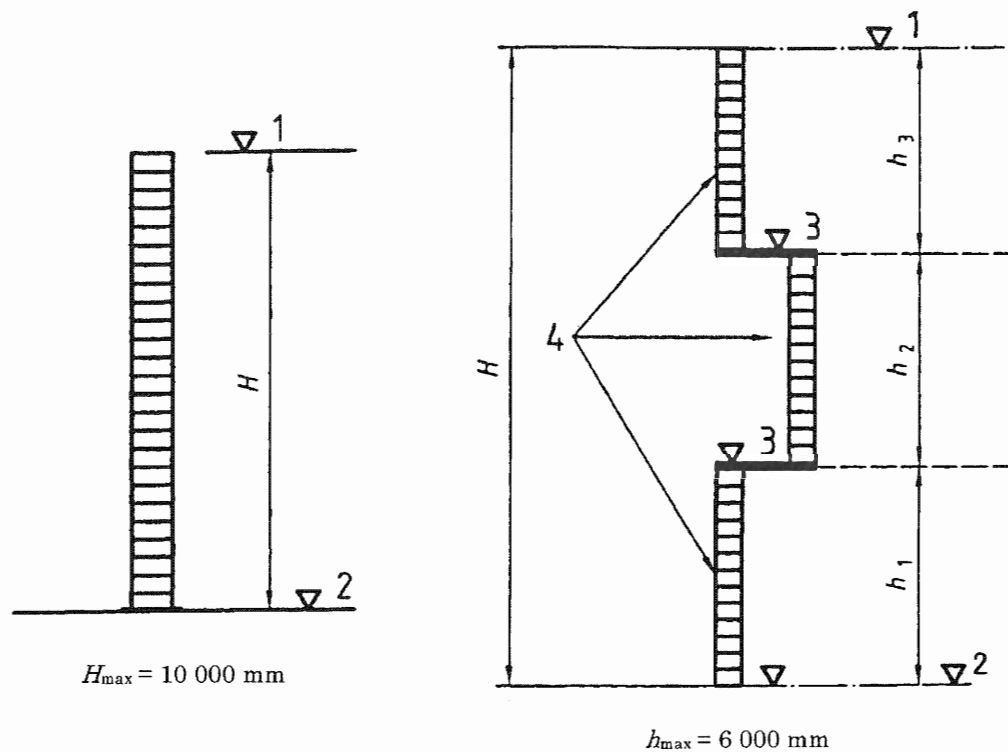


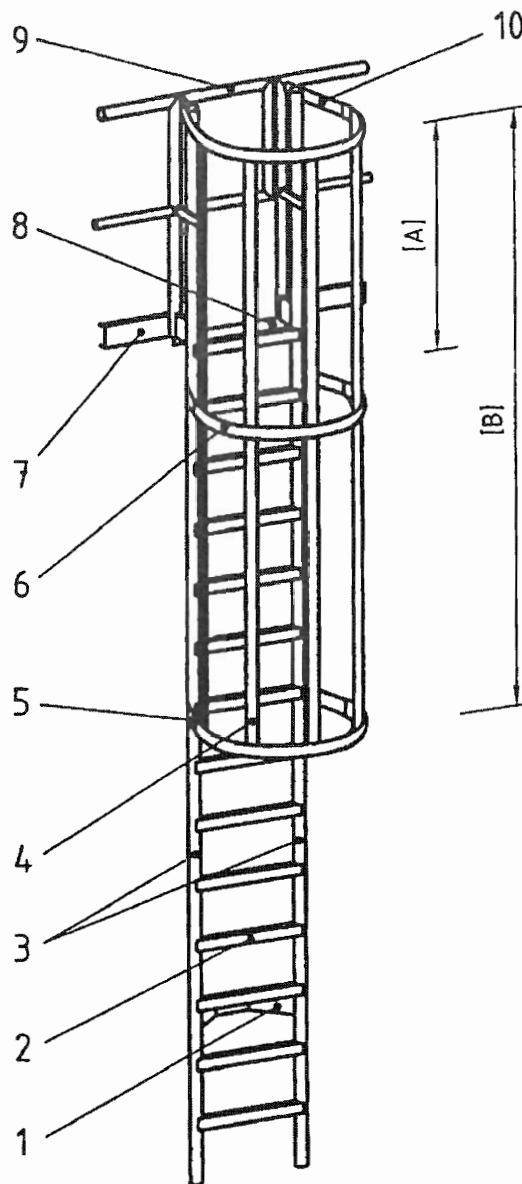
Figure 1.a Ladder without rest platform (single flight)

Figure 1.b Ladder with staggered flights

Key

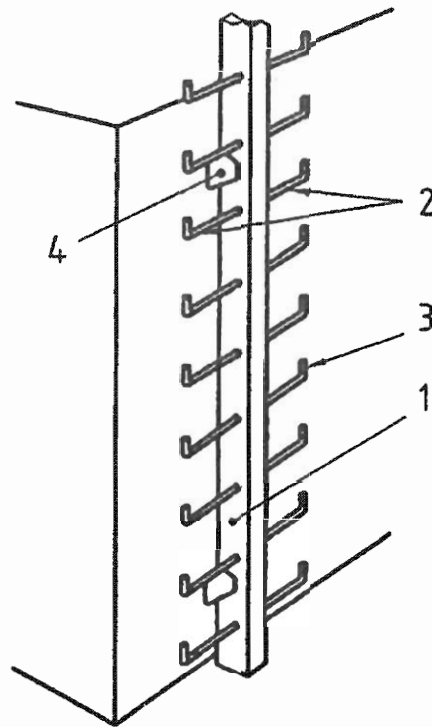
- 1 Arrival area
- 2 Departure area
- 3 Intermediate platform
- 4 Ladder flight: H , h_1 , h_2 , h_3

Figure 1 Height of flights and location of platforms



- Key
- 1 Anchor bracket
 - 2 Rung
 - 3 Ladder stile
 - 4 Safety cage vertical members
 - 5 Lowest hoop
 - 6 Intermediate hoop
 - 7 Toe plate
 - 8 Platform step
 - 9 Gate
 - 10 Upper hoop
 - [A] Exit section
 - [B] Safety cage

Figure 2 Terminology



Key

- 1 Stile
- 2 Rung
- 3 Protective device against slipping-off
- 4 Anchor point

Figure 3 Example of a ladder equal to or less than 3 000 mm with one stile

4 Safety requirements

4.1 General requirements The materials, dimensions of constituent elements and construction mode used shall meet the safety objectives of this part of JIS B 9713.

Ladders shall be designed to meet the same installation requirements as the machine, taking into consideration where necessary, conditions such as harsh environment, vibrations, etc.

As far as possible, fixed ladders should be designed with two stiles. In exceptional circumstances (e.g. a continuous ladder with a varying angle of pitch or insufficient space to provide two stiles), fixed ladders may be provided with only one stile.

All parts likely to be in contact with users shall be designed so as not to catch, hurt or hinder i.e. sharp corners, welds with burrs, or rough edges, etc. should be avoided. Opening or closing the mobile parts (gate) shall not cause further hazards (e.g. shearing or accidental falling) for persons using the ladder and those in the vicinity.

Fittings, hinges, anchor points, supports and mounting points shall hold the assem-

bly sufficiently rigid and stable to ensure the safety of users under normal conditions of use.

4.2 Strength of fixed ladders

4.2.1 General requirements A ladder, platform and safety cage (when installed) shall meet the following design requirements:

4.2.1.1 Ladder element The ladder elements are considered to fulfil the requirements mentioned in 4.2.1. The maximum deflection as indicated in 5.1 shall not exceed 50 mm.

Information 1 See 3.1 of EN 131-2 for the requirements for aluminium alloys, steels, plastics and wood used for ladder elements.

In case of fixed ladders with one stile instead of the lateral bending test a torsion test shall be made by application of two test loads each 400 N. The deflection of the ladder shall not exceed 20 mm (see 5.3.3 and figure 16). For the rungs, the load is applied on a length of 100 mm close to the lateral devices against slipping off. The residual deflection of the rungs shall be not more than 0.3 % related to the length of the rung (see 5.3.2, and figure 15).

Information 2 See 4.4 of EN 131-2 for the details of the lateral bending test.

4.2.1.2 Safety cage The safety cage is considered to meet these requirements if the permanent deformation as the result of a vertical load of 1 000 N is not more than 10 mm and as the result of a horizontal load of 500 N is not more than 10 mm. (see 5.2 and figure 13).

4.2.1.3 Fixed ladders equipped with a fall arrester In addition to the requirements of 4.2.1.1, the combination of fall arrester and ladder shall be capable of stopping the user from falling (see clause 5).

4.2.2 Fixing elements

4.2.2.1 General Fixing elements such as fittings, anchorage points, hinges, supports and mountings shall hold the assembly sufficiently rigid and stable to ensure the safety of user under normal conditions of use (see verification in 5.4).

In case of fixed ladders equipped with a fall arrester the connecting elements shall withstand the stresses caused by the fall arrester catching the person who falls down.

4.2.2.2 Anchoring points of fixed ladders The anchoring points and connections to them shall be capable of supporting 3 000 N per stile. Up to four anchorages may be considered to contribute to this support (see 5.4 for the test method).

4.2.3 Platforms All platforms shall comply with the requirements of JIS B 9713-2.

Unit: mm

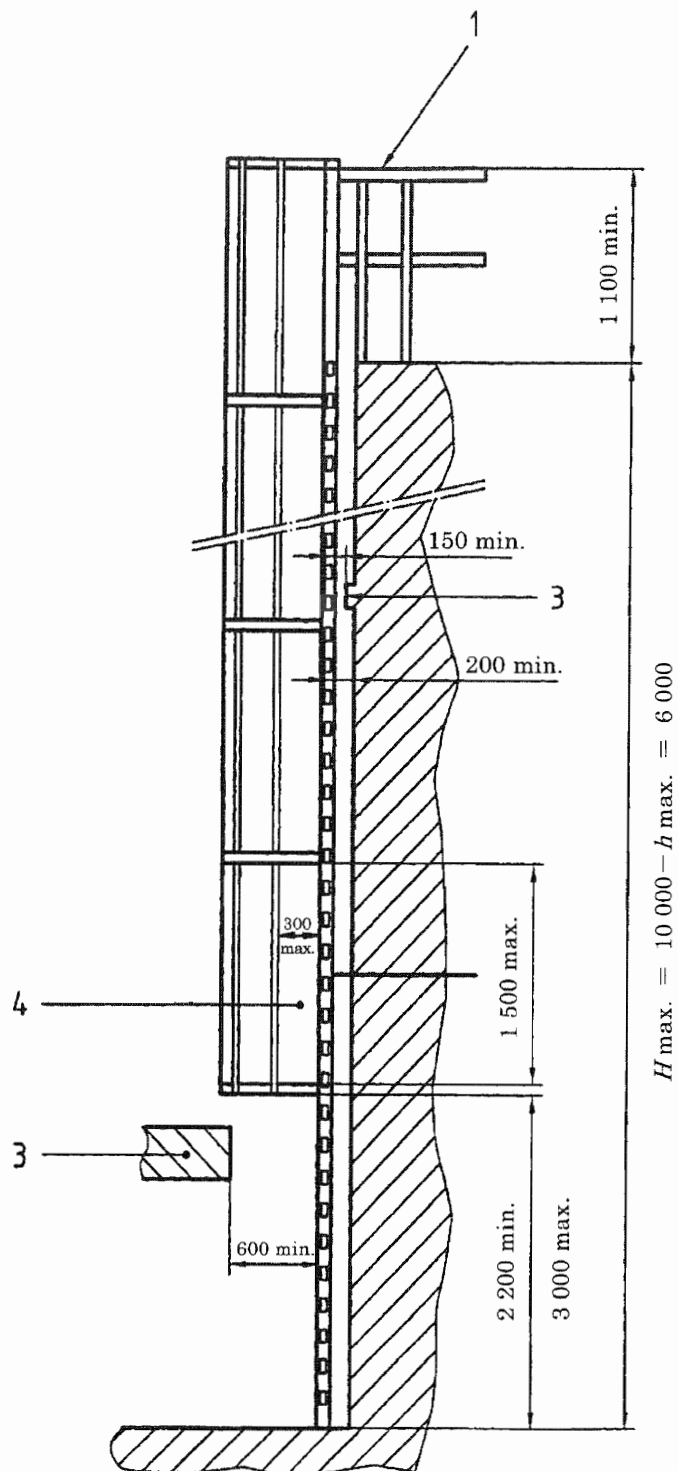


Figure 4.a Side elevation on ladder with a safety cage

Figure 4 Principal dimensions of ladders and safety cages

Unit: mm

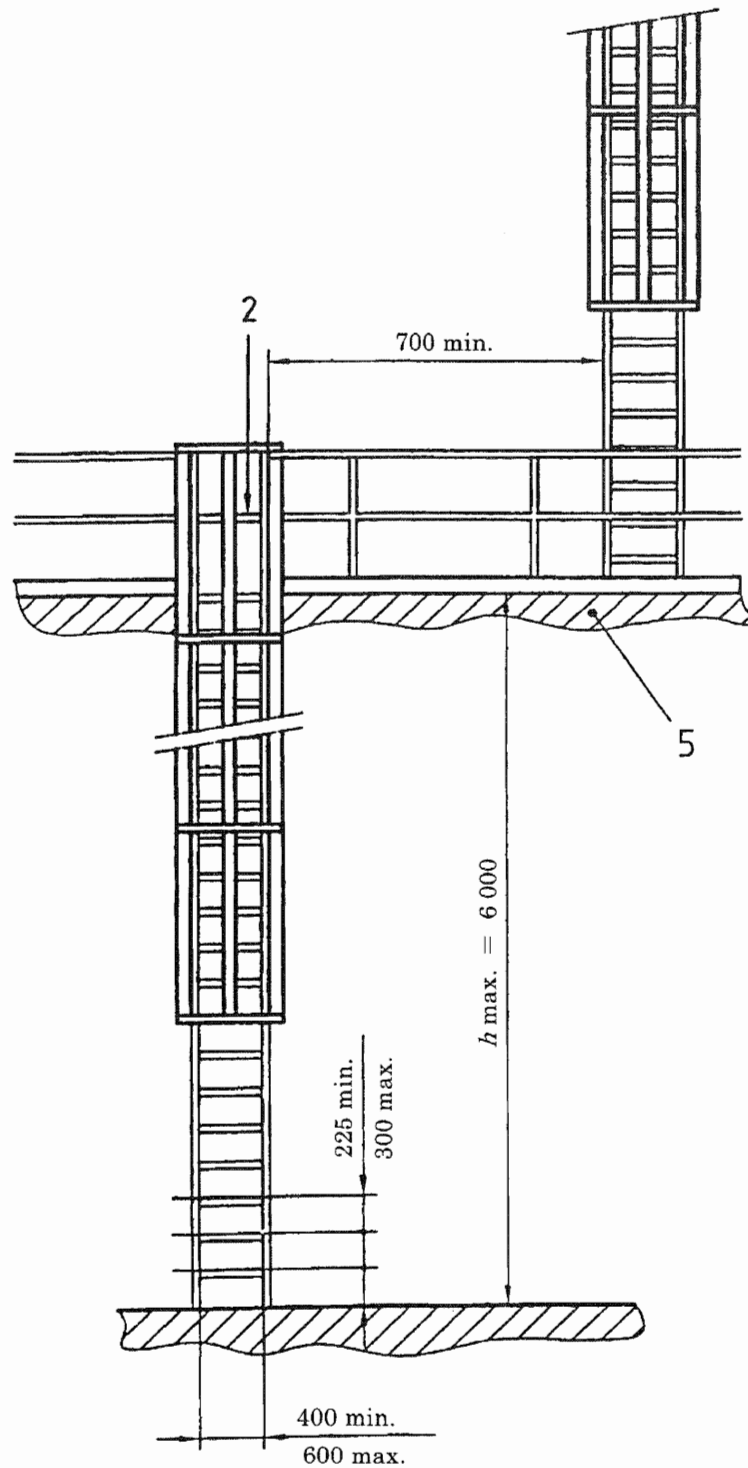


Figure 4.b Front elevation on ladder with safety cage
Figure 4 Principal dimensions of ladders and safety cages (continued)

Unit: mm

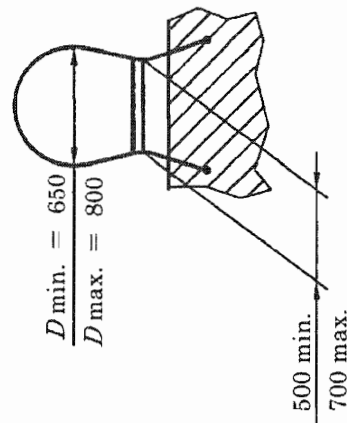


Figure 4.c Plan view of a ladder with a safety cage

Unit: mm

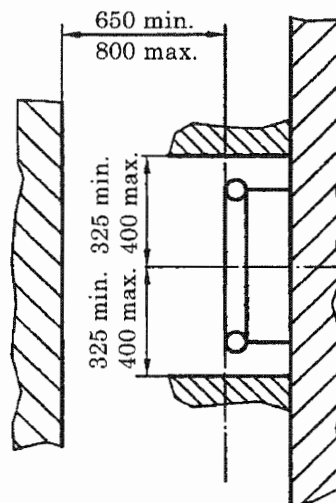


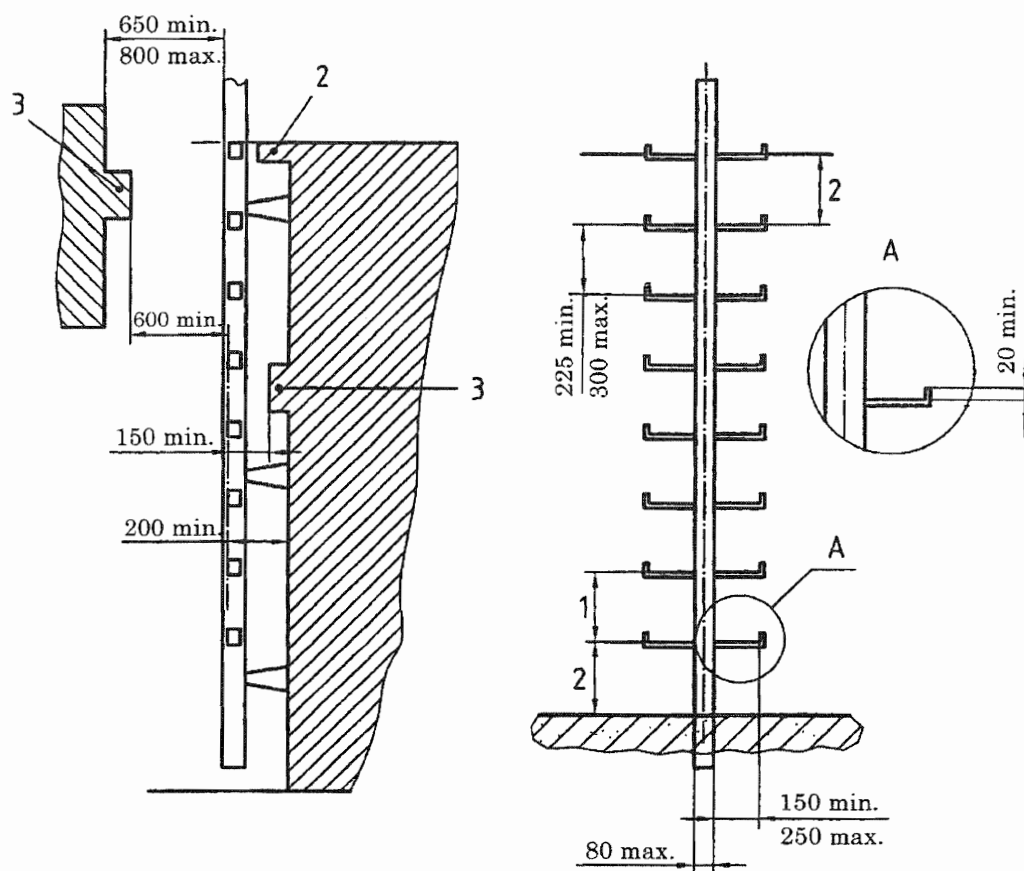
Figure 4.d Plan view of a ladder without safety cage

Key

- 1 Connection element
- 2 Gate
- 3 Discontinuous obstacle
- 4 To suit maximum open area $\leq 0.4\text{m}^2$
- 5 Intermediate platform

Figure 4 Principal dimensions of ladders and safety cages (concluded)

Unit: mm



Key

- 1 Spacing between the rungs (see 4.4.1.1)
- 2 Spacing between rungs and the departure and arrival area (see 4.4.1.2 and figure 6.a)
- 3 Discontinuous obstacle

Figure 5 Principal dimensions of a fixed ladder with one stile

4.3 Conditions for installation of a fall protection device

4.3.1 Conditions requiring the installation of a fall protection device The ladder shall be fitted with a fall protection device when:

- a) the height of the ladder flight is more than 3 000 mm;
- b) the height of the ladder is 3 000 mm or less, but at the departure area there is the risk of falling an additional distance. In this case, the total distance of fall from the upper level of the ladder could be more than 3 000 mm.

Note : Risk of falling is considered to exist when the distance from the centre of the ladder to the unprotected side of a platform (or similar structure) is less than 3 000 mm.

4.3.2 Choice of the type of fall protection device Two main alternatives for protection of the users of fixed ladders against falls from a height are safety cages or fall ar-

resters:

- the cage shall be the required choice, as it is a means which is always present and the actual level of safety is independent of the operator's actions;
- where it is not possible to use a cage, individual protective equipment shall be provided. The fall arrester is only effective if the user chooses to use it. If a harness with an incompatible sliding system (class 2 safety belt) is used with a guided type fall arrester, there will be a risk.

A fall arrester shall only be considered for low frequency and specialised access (e.g. maintenance).

Note : An appropriate individual fall protection device is able to arrest a fall better than a cage.

4.4 Ladder The principal dimensions of the ladder shall be determined in accordance with 4.4.1 to 4.4.4 (see also figures 4 and 5).

4.4.1 Position of the rungs

4.4.1.1 Spacing between the rungs The spacing between successive rungs shall be constant and shall be between 225 mm and 300 mm.

4.4.1.2 Spacing between rungs and the departure and arrival area It is recommended to use the same spacing between the walking surface of the departure area and the first rung which shall be the same as consecutive rises.

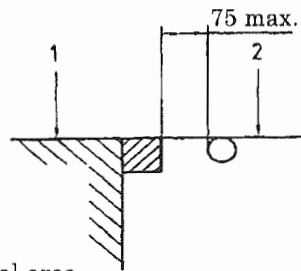
The distance between the walking surface of the departure area and the first rung shall not exceed the spacing between two consecutive rungs.

Note : In case of mobile machinery to be used on uneven ground, the distance between the walking surface of the departure area and the first rung can be 400 mm max.

The top rung shall be positioned at the same level as the walking surface of the arrival area (see figure 6.a). If the gap between the walking surface and the ladder is greater than 75 mm, a floor extension shall be provided at the arrival area to reduce this gap (see figure 6.a).

4.4.1.3 Position of rungs of fixed ladders with one stile The rungs at one side of the stile shall be on the same level as the respective rung at the opposite side of the stile (see figure 5).

Unit: mm



Key

- 1 Walking surface of the arrival area
- 2 Rung/tread surface

Figure 6.a Position of top rung

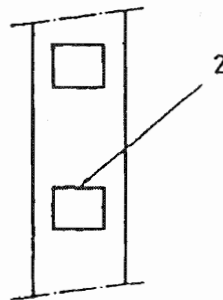


Figure 6.b Design of polygonal rungs—Recommended mounting

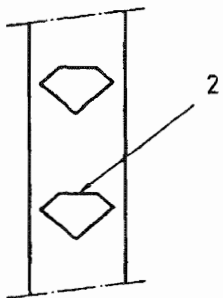


Figure 6.c Design of polygonal rungs—Mounting for special use only

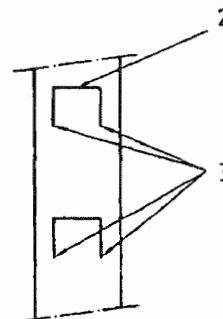


Figure 6.d Design of U-shaped profile rungs

Key

- 1 Walking surface of the arrival area
- 2 Rung/tread surface
- 3 No sharp edges

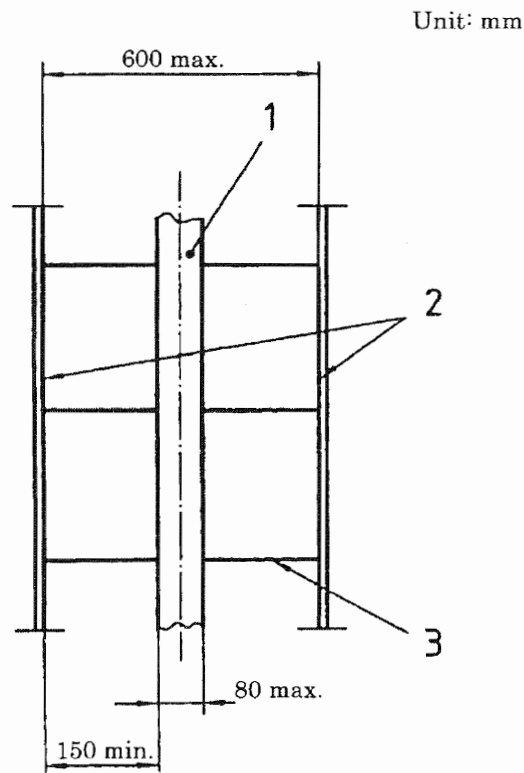
Figure 6 Position of rungs

4.4.2 Rungs

4.4.2.1 Position of polygonal and U-shaped rungs Polygonal and U-shaped rungs shall be positioned so that the tread walking surface is horizontal (see figures 6.b, 6.c, and 6.d).

4.4.2.2 Length of the rungs

- a) **Length of rungs of fixed ladders with two stiles** The clear width between the two stiles shall be between 400 mm and 600 mm (see figure 4). However, a shorter length between 300 mm and 400 mm is permissible, in cases where the immediate environment makes it impossible to use 400 mm. Before a shorter length is considered a check should be carried out to see if it is possible to find a more favourable position for the ladder allowing a clear width of 400 mm or more.
- b) **Length of rungs of fixed ladders with two stiles and a fall arrester** The clear width between the stiles and the rigid anchorage line for a guided type fall arrester shall be at least 150 mm and the thickness of the anchorage line shall not be more than 80 mm (see figure 7).



Key

- 1 Rigid anchorage line
- 2 Stile
- 3 Rung

Figure 7 Length of the rungs of a fixed ladder with two stiles and a rigid anchorage line for a guided type fall arrester

- c) **Rungs of fixed ladders with one stile** The clear width between the stile and the protective device against slipping-off shall be between 150 mm and 250 mm and the thickness of the stile shall not be more than 80 mm (see figure 5).

4.4.2.3 Cross-section of the rungs The diameter of the rungs shall be at least 20 mm, or the walking surface of the tread of polygonal or U-shaped rungs shall have a depth of at least 20 mm.

The cross-section of the rungs shall not be given dimensions difficult to grasp by hand. The diameter of the rung shall not be more than 35 mm.

4.4.2.4 Surface of the rungs The surface of the rungs shall not cause injuries, notably to hands, e.g. no sharp edges (see figure 6.d).

The surface of the rung shall have a slip resistant walking surface. Special measures to prevent slipping may be necessary when the risk of slipping is increased due to environmental conditions (oil, ice, etc.).

4.4.3 Devices against slipping-off The ends of the rungs of fixed ladders with one stile shall be fitted with protective devices against slipping-off laterally from the rungs. These protective devices against slipping-off shall have a height of at least 20 mm (see detail A of figure 5).

4.4.4 Spacing between the ladder and any permanent obstruction The space between the ladder and any permanent obstruction or obstacles shall be:

- in front of the ladder: at least 650 mm and 600 mm in case of a discontinuous obstacle;
- behind the front side of the rungs: at least 200 mm and 150 mm in case of a discontinuous obstacle.

See figures 4 and 5.

4.5 Safety cage The lowest part of safety cage, e.g. the lowest hoop shall start at a height of between 2 200 mm and 3 000 mm above the departure area. Below the cage on the chosen access side, the safety cage shall not have elements likely to obstruct the access to the area situated in front of the ladder. At the arrival area the safety cage shall be extended up to the height of the guard-rail of the arrival area (see figure 4).

The clear distances within the hoop of the safety cage shall be between 650 mm and 800 mm (see *D* in figure 4.c).

This applies equally to non-circular as well as circular safety cages. The distance from the rung to the safety cage shall be between 650 mm and 800 mm (see figure 4.d). With regard to the ladder axis, the distance from the surrounding structure in the absence of a safety cage shall be between 325 mm and 400 mm (see figure 4.d).

The clearance within the cage at the arrival area, measured along the transverse axis of the ladder rungs between the inside face of the cage shall be between 500 mm and 700 mm (see figure 4.c).

The distance between two hoops shall not exceed 1 500 mm and the distance between

two uprights on the cage shall not exceed 300 mm. The hoops shall be placed at right angles to the uprights on the cage. The safety cage uprights shall be fixed to the inside of the hoop and be equally spaced.

The spacing of safety cage components shall be designed so that the empty spaces are in any case not more than 0.40 m².

A cage is not necessary if surrounding structures (walls, parts of machines, etc) in front of and on the sides of the ladder provide a similar level of protection (e.g. by providing similar dimensions).

4.6 Guided type fall arrester on a rigid anchorage line Fall arresters shall meet the relevant requirements.

Information : See **EN 353-1**.

4.7 Departure and arrival areas—Platforms Departure and arrival areas as well as intermediate platforms shall meet the relevant requirements of **JIS B 9713-2**.

When required, guard-rails as protective devices against the risk of falling from a height at departure and arrival areas as well as at intermediate platforms shall meet the relevant requirements for guard-rails according to **JIS B 9713-3**.

4.7.1 Departure areas If the walking surface of the departure area has been raised by more than 500 mm above the surroundings or the departure area borders on areas which are not able to take a load, e.g. area made of glass or synthetic material, the departure area shall have guard-rails or equivalent means that are able to protect persons against falling from a height.

4.7.1.1 Access platforms If the departure area on the structure of a machine, a building, etc. cannot be considered as an area which meets the relevant requirement of **JIS B 9713-2**, an access platform shall be provided.

4.7.1.2 Fixed ladders with a safety cage If the horizontal distance from a fixed ladder, equipped with a safety cage, to the guard-rail of the raised departure area is not more than 1 500 mm, the guard-rail shall be fitted with an extension or the structure of the cage shall be extended down to the guard-rail (see figure 8).

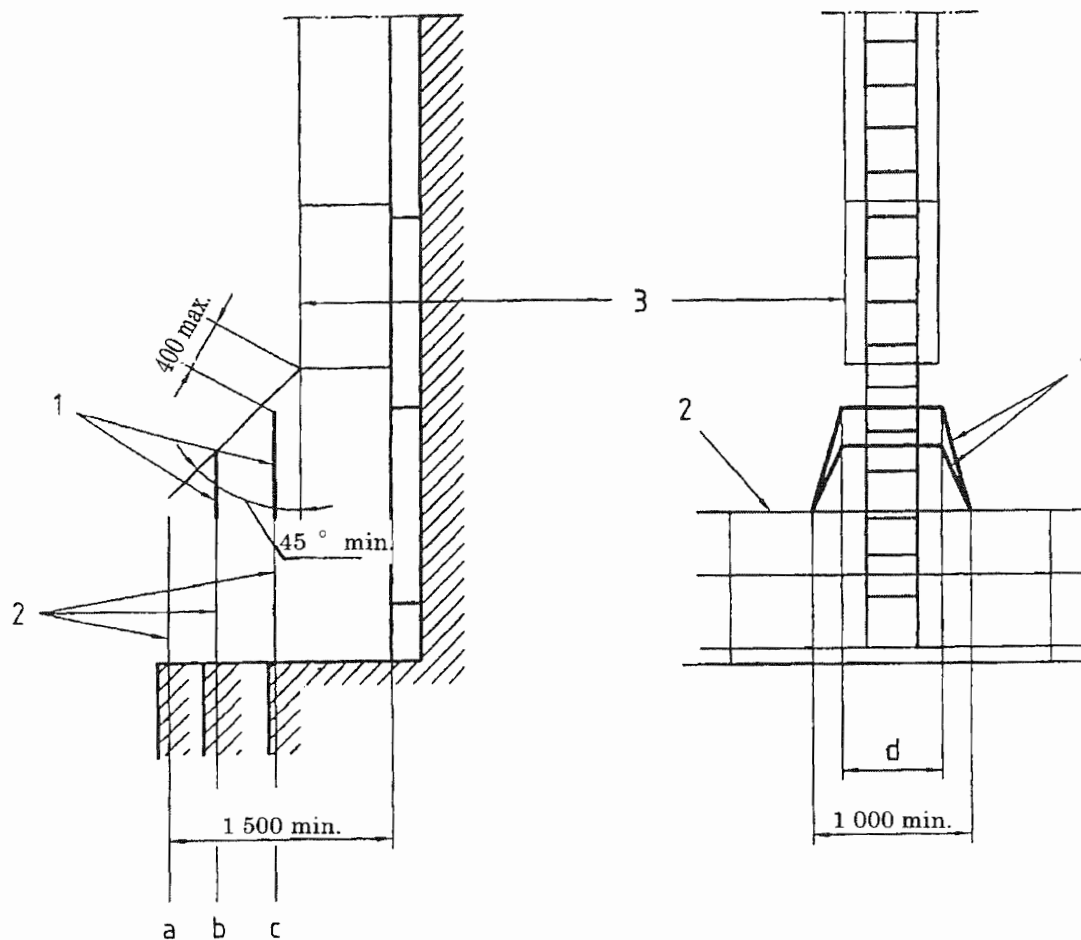
The top of the extension shall at least meet the following requirements:

- no dimension between the cage and the extension shall exceed 400 mm; or
- it shall have an angle, formed by the vertical and a straight line linking the upper section of the extension to the nearest part of the safety cage of 45 ° or more.

The components shall be positioned so that:

- the horizontal width of any space is not more than 300 mm; and
- the area of a free space is $\leq 0.40 \text{ m}^2$.

Unit: mm



Key

- 1 Extension
- 2 Guard-rail
- 3 Safety cage
- a Guard-rail without an extension
- b Height of the extension determined by an angle 45° minimum
- c Height of the extension determined by a distance 400 mm maximum
- d Diameter of the safety cage

Figure 8 Extension completing the protective function of guard-rails at the departure area

4.7.2 Arrival areas

4.7.2.1 Access platform If the arrival area on the structure of a machine, a building, etc. cannot be considered as an area which meets the relevant requirements of JIS B 9713-2, an access platform shall be provided.

4.7.2.2 Falling from a height Suitable means to prevent persons falling from a height, e.g. guard-rails, shall be provided at drop edges of arrival areas, over a length of at least 1 500 mm on both sides of the vertical axis of the ladder or over the entire

length of the edge, if this is less than 3 000 mm. This is independent of any fall protection device fitted beyond this length.

4.7.3 Access openings

4.7.3.1 Front or side exit Ladders may have a front or side exit to the arrival area.

The width of the access opening shall be between 500 mm and 700 mm.

4.7.3.2 Gates To prevent falling through the access opening at arrival areas the opening shall be provided with a gate.

The gates shall meet the following requirements:

- a) the opening direction of this gate shall not be towards the edge of the drop (outwards);
- b) the gate shall be designed so that it can be opened easily;
- c) the gate shall close automatically, e.g. by means of springs or the effects of gravity;
- d) the gate shall have at least a handrail and a kneerail according to relevant requirements of **JIS B 9713-3**.

4.7.3.3 Access through platforms by means of trap doors When it is necessary for technical reasons, a platform may have an opening to permit access to (and exit from) a ladder below the platform.

Protection against the risk of falling through such an opening shall be provided by a trap door or by guard-rails in combination with a gate. The guard-rail shall meet the requirements of **JIS B 9713-3** and the gate shall be according to 4.7.3.2 of this part of **JIS B 9713**.

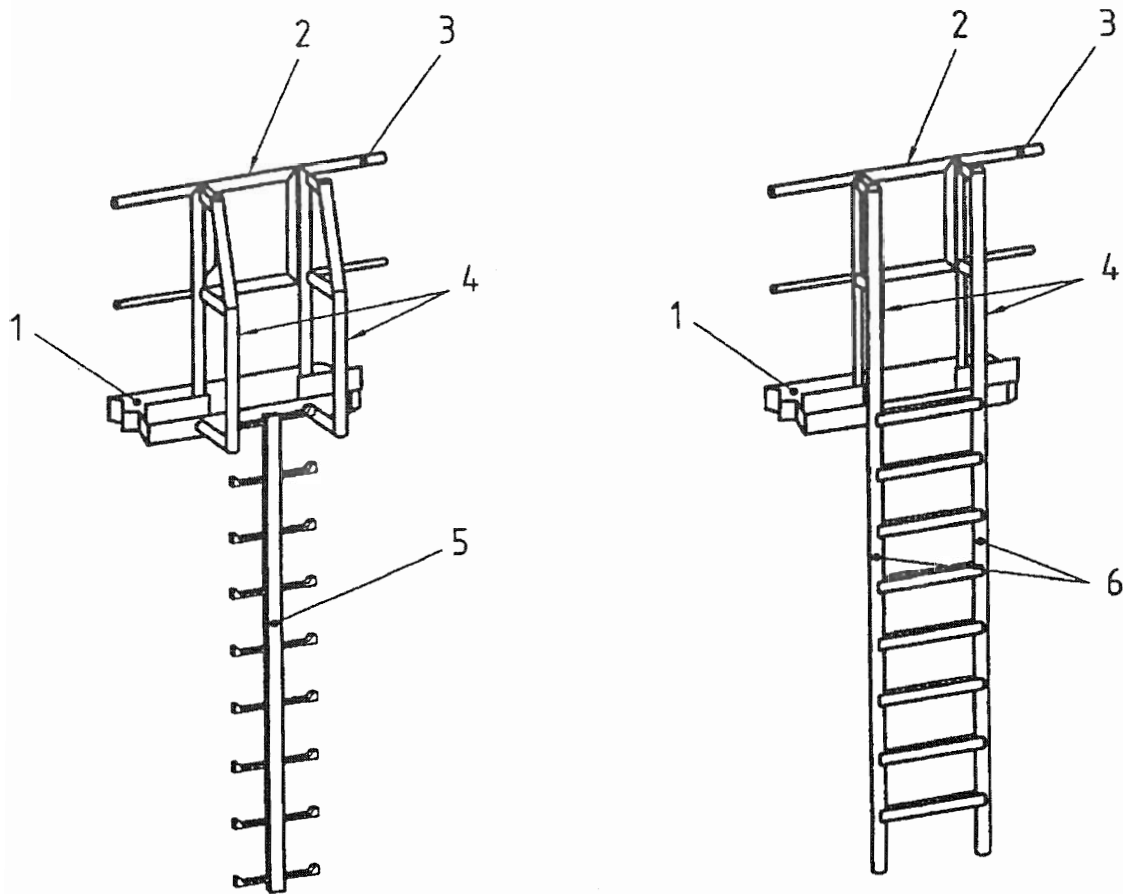
The trap door shall be designed so that:

- a) the opening shall be at least equal to the required size of the ladder cage (see 4.5);
- b) the trap door shall not open downwards. It shall move upwards or horizontally;
- c) opening the trap door shall be manual and easy;
- d) the trap door shall allow the safe passage of the operator whilst in the open position;
- e) closing of the trap door shall be done following safe passage without the intervention of the operator for example, springs, hydraulic means.

4.7.4 Climbing off and getting on to a fixed ladder safely

4.7.4.1 Ladder with two stiles and without a fall arrester (3 000 mm max) Handrails shall be fitted connecting the ladder stiles to the handrail of the guard-rail. Those handrails shall be fixed to the guard-rail at the arrival area (see figure 9, 4.7.3.1).

4.7.4.2 Ladder with one stile and without a fall arrester (3 000 mm max) Handrails shall be fitted on both sides of the ladder beginning at the level of the rung before the last rung, extending up the level of and connected to the handrail of the guard-rail at the arrival area (see figure 9).



Key

- 1 Walking surface of the arrival area
- 2 Gate
- 3 Guard-rail
- 4 Handrail
- 5 Ladder with one stile and without a fall arrester
- 6 Ladder with two stiles and without a fall arrester

Figure 9 Connected handrail at the arrival area

4.7.4.3 Arrangement for getting on and off ladders with a guided-type fall arrester
Suitable safeguards shall be provided, e.g. a locked device, to ensure that only authorised, trained and fully equipped operators (see also 4.3.2), can use the ladder.

Note : A written warning or audible signal are not adequate safeguards.

In addition, the fall arrester and its surroundings shall be designed so that the operator has to connect or disconnect in a safe position, e.g. by providing a continuous line or an automatically closing extendable platform.

4.7.5 Platforms

4.7.5.1 Cases where the installation of platforms are required Generally, if the climbing height H of fixed ladders is equal to or more than 6 000 mm the ladders shall

be equipped with one or more platform(s).

Where there are several flights, the height h of a ladder flight between the departure area and the nearest platform or between consecutive rest platforms shall be no more than 6 000 mm.

But in the case of a single flight only (no rest platform), the height h between departure area and the arrival area (see figures 1a and 1b) can be extended to no more than 10 000 mm.

4.7.5.2 Intermediate platforms The length of the intermediate platform shall be at least 700 mm installed between the two flights of the ladder (see figure 4.b). In this case the requirement of 4.7.1 and 4.7.2 apply.

These platforms shall be equipped with a gate with dimensions to suit emergency situations.

4.7.5.3 Rest platforms The width of a rest platform shall be at least 700 mm (see figure 10).

Unit: mm

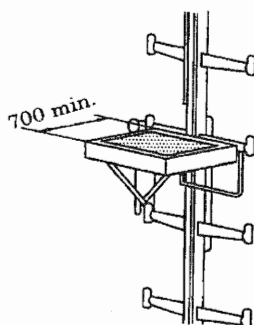


Figure 10 Example of a rest platform

4.7.5.4 Movable rest platforms For ladders with one stile or guided type fall arresters the movable rest platforms shall be at least 400 mm wide and 300 mm long or consist of 2 parts at least 130 mm wide and 300 mm long.

Unit: mm

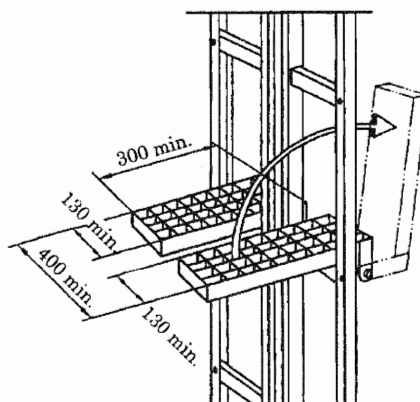


Figure 11 Example of a movable rest platform

4.7.5.5 Staggered ladder flights If the layout of the machine or its environment make it unavoidable to do otherwise, two successive ladder flights may be adjacent (see figure 4), without a separate platform. In this case the lower flight of the ladder shall be extended to where the highest rung is at least 1 680 mm above the platform to provide good handholds for the user of the ladder. The height of the guarding above the platform shall be at least 1 600 mm (see figure 12).

The clear height for the passage between the platform and the lowest complete hoop of the safety cage on the upper ladder shall be between 2 200 mm and 2 300 mm.

Unit: mm

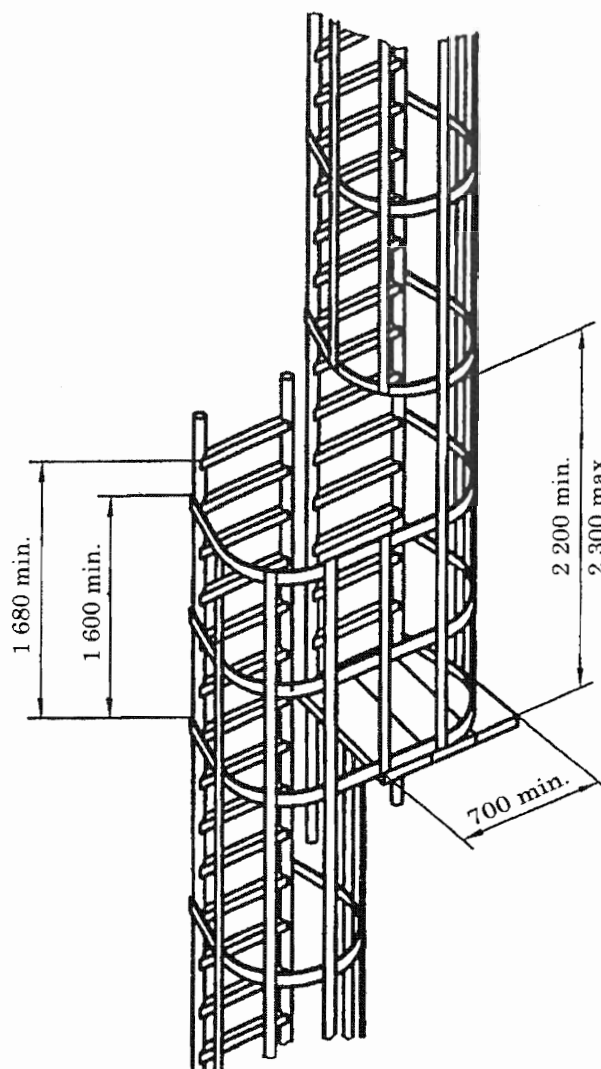


Figure 12 Example of adjacent staggered ladder flights including a rest platform

5 Verification of safety requirements The stipulated safety requirements and/or measures shall be assessed by measurements, inspection, calculation and/or testing.

When testing is used, type test shall be according to the testing procedure described in this clause.

5.1 Tests of fixed ladders with two stiles The ladder element shall satisfy the following tests:

— strength test of the ladder

Information 1 The relevant provision in 4.2 of EN 131-2 (indicated with “ ”) is shown below.

“The test shall be carried out on the complete ladder. A pre-load of 500 N shall be applied for a duration of one minute. The position of the ladder after removal of the pre-load is the origin for measurement. A test load of 1 000 N shall be applied for a duration of one minute. The measurement shall be taken one minute after removal of the test load. The permanent deformation of the ladder shall not exceed 1 % of the distance L between the supports.”

— bend test of ladder

Information 2 The relevant provision in 4.3 of EN 131-2 (indicated with “ ”) is shown below.

“The test shall be carried out on the complete ladder. A pre-load of 100 N shall be applied for a duration of one minute. The position of the ladder after removal of the pre-load is the origin for measurement. A test load of 750 N shall be applied vertically on the centre of the ladder for a duration of at least 1 minute. Thereby the maximum permissible deflection f_{\max} , as a function of the distance L between the supports can be:

— $f_{\max} = 5 \cdot L^2 \cdot 10^{-6}$ in mm, for ladders of length less or equal to 5 m

— $f_{\max} = 0.043 \cdot L - 90$ in mm, for ladders of length more than 5 m and less or equal to 12 m

— $f_{\max} = 0.06 \cdot L - 294$ in mm, for ladders of length more than 12 m.

The test shall be performed in the direction of use of the ladder. If the ladder can be used from both sides, the test shall be performed in the least favourable direction.”

— lateral bending test of ladder

Information 3 The relevant provision in 4.4 of EN 131-2 (indicated with “ ”) is shown below.

“The ladder shall be placed in lateral position. A pre-load of 100 N shall be applied for the duration of one minute. The position of the ladder after removal of the pre-load is the origin for measurement. A load of 250 N shall be applied to the lower stile equidistant from the supports. The deflection is measured equidistant front the supports 1 minute after loading. Thereby the maximum permissible deflection f_{\max} , as a function of the distance L between the supports can be: $f_{\max} = 0.005 \cdot L$ in mm.”

— bend test of rungs

Information 4 The relevant provision in 4.6 of EN 131-2 (indicated with “ ”) is shown below.

“A pre-load of 200 N shall be applied for the duration of one minute. The position of the rung/step/platform after removal of the pre-load is the origin for measurement. In the position of use of the ladder a test load of 2 600 N shall be applied vertically on the mid-point of the weakest rung or step of any design evenly distributed over a width of 100 mm and for the duration of one minute. The maximum permanent deformation after removal of the test load shall be 0.5 % of the inner width, measured underneath the tested step.”

— torsion test of rungs

Information 5 The relevant provision in 4.7 of EN 131-2 (indicated with “ ”) is shown below.

“A torque of 50 N·m shall be applied on the mid-point of the rung or step via a 100 mm wide clamping device. The torque shall be applied alternately 10 times in clockwise and 10 times in counter-clockwise direction for a period of 10 seconds each. During testing there shall be no relative movement in the connection between stile and rung/step. After the test a permanent deformation shall be $\pm 1^\circ$ at maximum. The tests shall be performed on one ladder and in the order as listed above.”

Information 6 The relevant provision in 4.1 of EN 131-2 (indicated with “ ”) is shown below.

“For all tests the following value is permitted as uncertainty of measurement:

± 1 mm for longitudinal measurements

± 5 mm for the measurement of the distance between the supports

$\pm 1^\circ$ for the measurement of angles.

For the bend or lateral bending tests the following test conditions shall be complied with:

— The ladder shall be placed horizontally on supports situated 200 mm from each end of the ladder. Hinges of standing ladders are to be regarded as the ends of the ladders,

— the supports shall be cylindrical with diameters between 25 mm and 100 mm and shall be free to rotate,

— the test load shall be slowly applied in the middle of the ladder equally to both stiles over a length between 20 mm and 100 mm while it has to be taken care that an applying by jerks is avoided.”

The distance L to be taken into account for the strength, bend and lateral bending tests, is the distance in mm between two consecutive anchor points of the ladder (see point 4 in figure 16).

Acceptance criterion of the bending test (see information 2 of 5.1) is modified as follows: The maximum deflection admissible under load shall be no more than $5 \times L^2 \times 10^{-6}$ in mm without exceeding 50 mm.

5.2 Testing of the safety cage

5.2.1 The test is carried out under the same conditions as those likely to exist at the place where it would be used. The safety cage is fixed to the ladder. The two tests take place in accordance with figures 13 and 14.

5.2.2 For the safety cage hoop, a preload (F_{PL}) of 200 N is applied vertically at the most unfavourable point (see figure 13). The preload may be distributed over three horizontal safety cage hoops for one minute providing the connections between the uprights of the cage and the safety cage hoops are tension proof. The position of the lowest safety cage hoop after removing the preload is taken into account as a reference position for the test to be carried out for a test load (F_T) of 1 000 N. The permissible permanent deformation which is measured at the point of application of the load is no more than 10 mm.

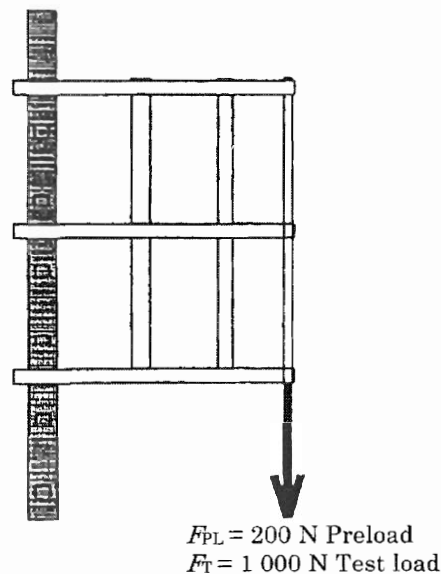


Figure 13 Test of a safety cage

5.2.3 For the uprights, a simulated load (F_H) of 500 N shall be horizontally applied at the most unfavourable point. The simulated load (F_H) may be distributed over three uprights (see figure 14). The permissible permanent deformation measured at the point of application of the load is 10 mm maximum. Test cages recording any permanent deformation shall not be used in service.

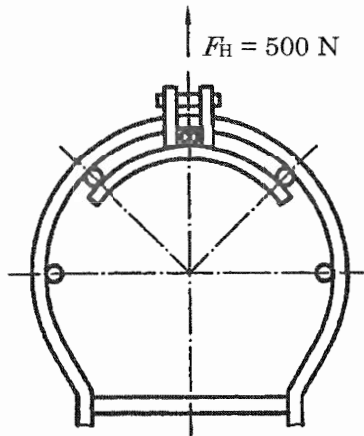


Figure 14 Testing of the safety cage

5.3 Tests of fixed ladders with one stile

5.3.1 Strength and bending of a ladder element [Torsion of the rungs] The ladder element shall satisfy the tests specified in 5.1:

- Strength test (see information 1 of 5.1);
- Bending test (see information 2 of 5.1);
- Torsion test on the rungs (see information 5 of 5.1).

Whereby the distance L to be taken into account for strength and bending tests shall be the longest distance between two consecutive anchor points of the ladder (see point 4 in figure 18).

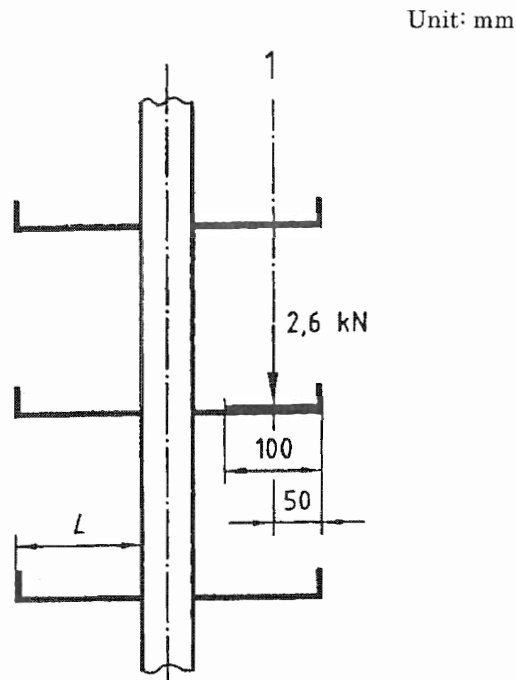
Acceptance criteria of the bending test (see information 2 of 5.1) is modified as follows: The maximum admissible deflection under load shall be $\leq 5 \times L^2 \times 10^{-6}$ (mm) without exceeding 30 mm.

5.3.2 Strength of the rungs The bending test of the rungs of ladders with one stile shall be carried out as shown in figure 15.

A preload of 200 N perpendicular to the top of the rungs is applied for 1 min. The position of the rung after removing the preload is taken into account as a reference position for the test carried out with the test load.

The direction of the preload and of the test load of 2.6 kN is perpendicular to the top of the rungs. The preload and test load are equally distributed on a length of 100 mm close to the lateral devices provided at the end of the rungs to prevent slipping.

After removing the test load, the residual deflection of the rungs shall be not more than 0.3 % related to the length L of the rung. Point of measuring is at a distance of 50 mm from the lateral protective device provided at the end of the rung to prevent slipping-off; the direction of measuring to be in the line of application of the test load. Measuring of the deflection of the rungs shall be carried out no less than one minute after removing the test load.



Key

1 Line of application

Figure 15 Test method for the rungs of a ladder with one stile

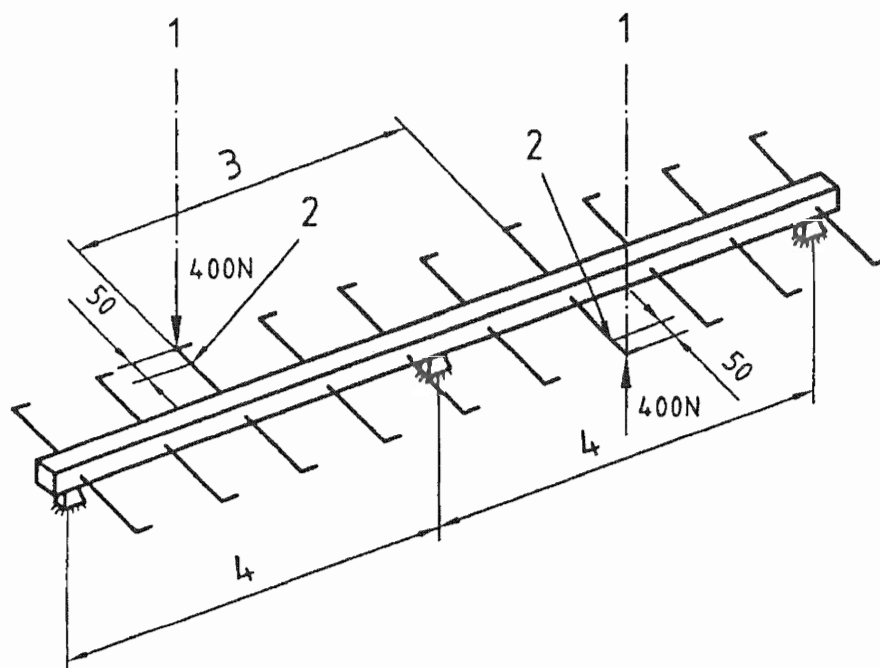
5.3.3 Strength of the stile The ladder shall be stressed by two forces according to figure 16.

The direction of both test loads of 400 N is perpendicular to the face of the ladder. The length of the ladder is at least two distances between consecutive anchor points. The ladders shall be mounted at the anchor points on the ground.

The distance between the test loads corresponds to the distance between four sets of rungs of the ladder. The test loads are applied to the point considered as the most unfavourable.

The deflection of the ladder shall not exceed 20 mm under the application of the test loads. Measuring points on the rungs stressed by the test loads shall be at a distance of 50 mm from the lateral protective devices used to prevent slipping-off. The direction of measuring shall be in the line of application of the test loads.

Unit: mm

**Key**

Two test load each 400 N

1 Line of application

2 Measuring point

3 Distance between four sets of rungs

4 Distance between two consecutive anchor points

Figure 16 Torsion test of a ladder with one stile**5.4 Test of the anchor points**

5.4.1 Fixed ladders with two stiles without fall arrester The strength of the anchor points of fixed ladders with two stiles shall be calculated taking into account a force of 3 kN for each stile, directed along the centre line of each stile (see figure 17).

At each stile, no more than four anchor points shall be taken into account by which the forces will be transmitted to fixed parts of the surroundings (e.g. wall, enclosure of the machine, etc.).

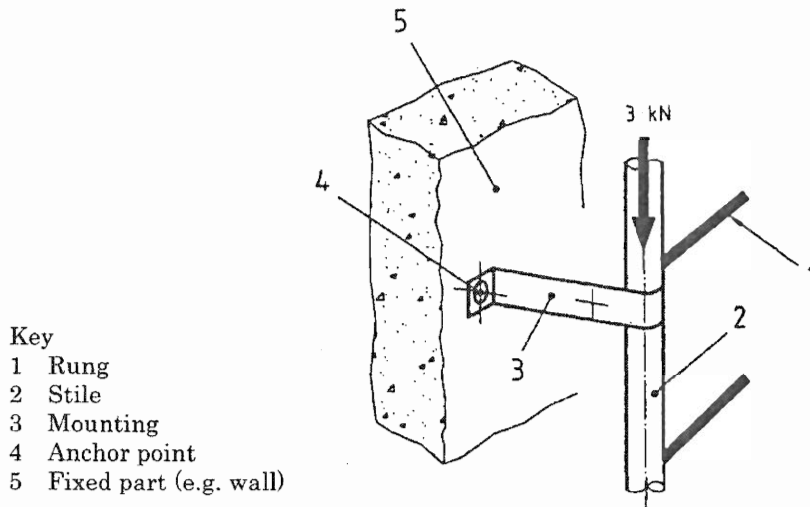


Figure 17 Arrangement for assessment of anchor points and connections of fixed ladders with two stiles

5.4.2 Fixed ladders with one stile The strength of the anchor points of fixed ladders shall be calculated taking into account a force of 6 kN, directed along the centre line of the stile. (see figure 18).

At each stile, no more than four anchor points shall be taken into account by which the forces will be transmitted to fixed parts of the surroundings (e.g. wall, enclosure of the machine).

5.4.3 Fixed ladder with fall arrester

5.4.3.1 The fall arrester shall be tested according to the relevant provisions.

Information : See EN 353-1.

5.4.3.2 The stile and anchorage points of the ladder shall be tested taking into account a single force of 6 kN directed along the centre line of the stile. The ladder shall support the load without fracture.

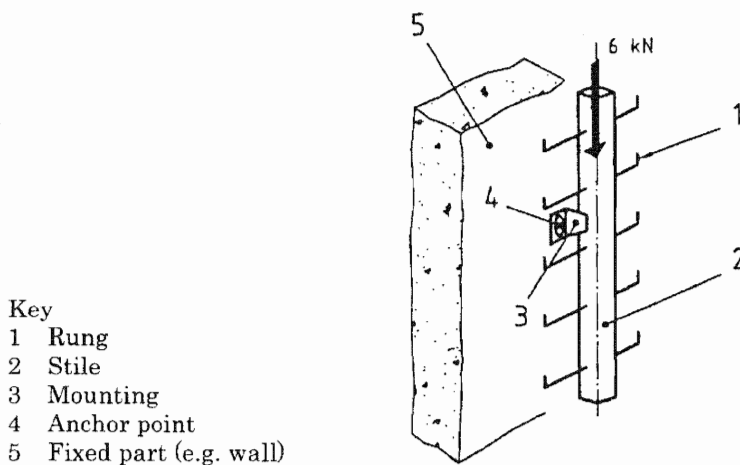


Figure 18 Arrangement for assessment of anchor points and connections of fixed ladders with one stile

6 Assembly and operating instructions

6.1 Assembly instructions All information on the correct assembly shall be contained in the instructions, including the method of fixing and the assembly of the fall arrester, where applicable.

6.2 Operating instructions for ladders with fall arresters The provisions of ISO 12100-2 shall be contained in the operating instructions.

Information : See also EN 353-1

6.3 Marking at points of entry and exit Ladders with fall arresters shall be permanently marked with the following information:

- type of guided type fall arrester and year of manufacture,
- notice: “Use of Personal Protective Equipment is mandatory”

The marking is only required to be applied to those points of entry and exit which are reachable via the respective ladders.

Note : A marking, for example, by an embossed coating is considered permanent.

Annex A (informative) Bibliography

This annex is to supplement the matters related to the text and not to constitute the provisions of this Standard.

In compiling this Standard the following have been taken account:

- | | |
|-------------|--|
| JIS B 9702 | <i>Safety of machinery—Principles of risk assessment</i> |
| JIS B 9707 | <i>Safety of machinery—Safety distances to prevent danger zones being reached by the upper limbs</i> |
| JIS B 9708 | <i>Safety of machinery—Safety distances to prevent danger zones being reached by the lower limbs</i> |
| JIS B 9711 | <i>Safety of machinery—Minimum gaps to avoid crushing of parts of the human body</i> |
| ISO 12100-1 | <i>Safety of machinery—Basic concepts, general principles for design—Part 1: Basic terminology, methodology</i> |
| ISO 12100-2 | <i>Safety of machinery—Basic concepts, general principles for design—Part 2: Technical principles</i> |
| EN 131-2 | <i>Ladders—Requirements, Tests, Markings</i> |
| EN 353-1 | <i>Personal protective equipment against falls from a height—Guided type fall arresters on a rigid anchorage line</i> |
| EN 363 | <i>Personal protective equipment against falls from a height—Fall arrest systems</i> |
| EN 364 | <i>Personal protective equipment against falls from a height—Test methods</i> |
| EN 547-1 | <i>Safety of machinery—Human body dimensions—Part 1: Principle for determining the dimensions required for openings for whole body across into machinery</i> |
| EN 547-2 | <i>Safety of machinery—Human body dimensions—Part 2: Principle for determining the dimensions required for access openings</i> |
| EN 547-3 | <i>Safety of machinery—Human body dimensions—Part 3: Anthropometric data</i> |
| EN 1070 | <i>Safety of machinery—Terminology</i> |

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